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DENTAL ROOTS

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DENTAL ROOTS

A History of Dentistry
from Early Times to
the Nineteenth Century

April 21 - June 13, 1986

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Disorders of the teeth and mouth have afflicted mankind since the dawn of time. Yet it was only during the eighteenth century that dentistry emerged as a separate branch of medicine concerned with the structure, function and therapeutics of the teeth and gums, together with their surgical and prosthetic treatment. Prior to the eighteenth century, disorders of the mouth were regarded as part of general medicine. Dental diagnosis and therapeutics were performed by a physician, while extraction was usually entrusted to a barber, blacksmith, itinerant toothdrawer, or to some other person with little or no formal medical training. During this period reference to dental problems and their treatment were scattered throughout general books of medicine, and few treatises dealing specifically with the teeth were written. It was not until 1728, with the publication of Pierre Fauchard's Le chirurgien dentiste, that a true dental science, with its attendant specialized education and training, began to evolve.

It is the purpose of the present exhibition to display some of the landmarks in the history of dentistry, from the time of the ancient Egyptians to the end of the nineteenth century. Most of the books in the exhibition are part of the Harry R. Abbott Memorial Library, donated to the Thomas Fisher Rare Book Library by the Faculty of Dentistry of the University of Toronto in 1981. The dental instruments and artifacts in the display have been generously lent by the Museum of the History of Medicine, Academy of Medicine, Toronto, and by the Faculty of Dentistry of the University of Toronto.

CASE 1: THE ANCIENT WORLD: EGYPT

Knowledge of medical practices among the earliest civilizations of the Middle and Far East is extremely scanty. There exists some evidence to suggest that primitive surgical, including dental, procedures were performed by the ancient peoples of Mesopotamia and China, but it is only with the Egyptians that medical science makes any significant progress. Yet even here information is scarce.

The Edwin Smith Surgical Papyrus. Published in facsimile and hieroglyphic transliteration with translation and commentary in two volumes by James Henry Breasted. Chicago: University of Chicago Press, 1930.

Papyros Ebers: das hermetische Buch über die Arzeneimittel der alten Ägypter in hieratischer Schrift. Herausgegeben, mit Inhaltsangabe und Einleitung versehen von Georg Ebers. Leipzig: W. Engelmann, 1875.

Most of our knowledge of dental practices in ancient Egypt derives from archaeological sources. Examples of the implantation of ivory and wooden teeth and the attachment of loose teeth to sound adjacent teeth by means of gold wire have been discovered in remains excavated from tombs in Lower and Upper Egypt. The archaeological evidence has been supplemented by the written record provided by two papyri, discovered at Luxor within a few years of each other.

The first, purchased in 1862 by the American collector, Edwin Smith, after whom it is named, dates from the beginning of the New Kingdom, ca. 1700 B.C. The significance of the text, which is written in hieratic characters, was not recognised until 1930 when James Henry Breasted published this facsimile edition. The papyrus is essentially an account of the surgical treatment of injuries sustained in war or accidents. The part of the text displayed here describes the treatment of a dislocated jaw.

The second papyrus, discovered in 1873 by Professor Georg Ebers, was made public in this facsimile edition printed at Leipzig in 1875. Written around 1550 B.C., also in hieratic characters, the Papyros Ebers is thought to have its origin in a more distant past and may be a composite work of writings from different epochs. Passages referring to the teeth describe medications to be applied in treating various disorders of the teeth and gums.

CASES 2 & 3: THE ANCIENT WORLD: GREECE AND ROME

Hippocrates. Opera omnia. Per M. Fabivm Calvvm ... latinitate donata, nunc primum in lucem aedita ... Romae: [Aloysius et Valerius Doricus] 1549.

The ancient Greeks, having inherited much of the Egyptian medical knowledge, considerably advanced the art of healing. In particular, the teaching of Hippocrates (fl. 5th century B.C.) had a profound influence on the development of medicine.

Hippocrates stressed that morbid conditions have physical causes and were due to an imbalance of the bodily humours, and not to supernatural or magical influences as was generally believed. In advocating the careful physical examination of the patient, Hippocrates placed the art of healing on a firm scientific foundation. Although the Hippocratic canon contains no single book devoted exclusively to the teeth, his works are liberally interspersed with observations on dental and oral conditions, and clearly demonstrate the great importance that he and his contemporaries attached to the health of the teeth and mouth.

Dental pathology is prominent in Hippocrates's writings, particularly in his Epidemiorum libri, a series of case studies. Here he describes a number of dental and oral afflictions, including alveolar abscess, necrosis of the jaw, periostitis, problems associated with wisdom teeth, and irregularities of the teeth and palate. Of especial interest is the section of his De carnibus entitled "De dentitione", in which the pathological disturbances associated with teething, such as tender gums, convulsions, fever, diarrhoea, etc., are described in the form of aphorisms. Hippocrates was the first to observe that teeth are found in the foetus during the seventh month, although they begin to show only in the seventh month after birth.

His therapeutics contain much sound advice, but also some strange remedies. To dispel toothache, for instance, he prescribes gargling with castoreum and pepper, while boiled lentils are recommended as a cure for oral abscesses. Hippocrates stressed the undesirability of extraction which he believed to be fraught with danger -- an attitude which was shared by many of his successors.

Aristotle. Libri omnes, ad animalivm cognitionem attinentes, Cvm Averrois ... variis in eosdem commentariis. Sextvm volvmen. Venetiis: Apvd Ivntas, 1550.

Among the voluminous writings of Aristotle, De partibus animalium, regarded as the first work of comparative zoology, is of particular significance in the history of dentistry, especially with regard to dental anatomy. Aristotle devotes an entire

chapter to the study of the dental systems of various classes of animals. He observes that in all creatures the teeth have a common function, namely, the reduction of food; the form, arrangement, and number of teeth are determined by the type of food eaten. In addition, the teeth have special functions, for instance, as weapons of offence or defence. Human teeth are unique by virtue of their function in the articulation of speech. Many of Aristotle's observations are extraordinarily accurate and anticipate one of the basic criteria of zoological classification: dental morphology. Not all of Aristotle's observations, however, are valid, and some of his errors were repeated for many centuries. He claims, for example, that men have more teeth than women; that individuals with many teeth generally live longer than persons with few teeth; that the teeth actually grow in length to compensate for erosion through mastication.

Aulus Cornelius Celsus. Artivm liber sextvs, idem medicinae. In: Medici antiqvi omnes, qvi latinis literis diversorvm morborvm genera & remedia persecuti sunt. Venetiis: Aldvs, 1547.

It is uncertain whether Aulus Cornelius Celsus (25 B.C.-A.D. 50) was a physician by training. His writings encompassed many subjects including agriculture, rhetoric, warfare, as well as medicine, but only his medical writings have survived. Usually known by the collective title De medicina, they reveal a profound theoretical knowledge of surgical and medical procedures.

Much of Celsus's medical knowledge was gleaned from the Greeks and his writings represent the summation of the medical and surgical sciences of the ancients. De medicina devotes much space to hygiene and diseases of the mouth, as well as to ailments connected with dentition. Celsus was the first to insist on the role of prevention. In treating toothache he recommends the application of hot poultices, fumigation, purgatives and other medications. If none of these measures alleviates the pain, extraction is recommended only as a last resort. First the gum should be separated from the tooth which is then loosened by the fingers, if possible, or with forceps. Celsus advocates the filling of a decayed tooth with lint wadding or lead to prevent it from splintering under the pressure of the forceps. This is probably the first record of filling carious teeth, although it is not for their preservation. Celsus's sound advice on extraction was still being repeated centuries later by the Arab physicians and by Ambroise Paré in the sixteenth century.

Pliny the Younger. The historie of the world, commonly called The natvrall historie. Translated into English by Philemon Holland. London: Impensis G.B., 1601.

A contemporary of Celsus, Pliny the Younger (Caius Plinius Secundus) travelled widely throughout the Roman Empire, where he was able to gather a wealth of material for his encyclopaedic Historia naturalis, the work for which he is principally remembered. A fascinating compilation, Historia naturalis is so full of superstition, fable, and error, that it is often difficult to separate fact from fiction, especially as Pliny cites hearsay without disclaiming its validity. Yet it is this very mixture of science and fantasy that gives the work its interest; for it reveals the confused state of the natural sciences during the first century A.D., and demonstrates the conspicuous role still played by superstition in the medical sphere. Comments on the teeth are common in the thirty-seven books that comprise Historia naturalis, remedies for toothache being particularly numerous. One such "cure", for instance, recommends scratching the gums around the troublesome tooth with the tooth of a man who has suffered a violent death. Another recommends touching the affected area with a tooth taken from the left side of a hippopotamus's jaw. Yet another suggests boiling earthworms in oil, which should then be dripped down the ear on the same side as the toothache. Elsewhere the filling of hollow teeth with the ashes from mouse dung or from the dried liver of lizards is recorded. Not all of the remedies mentioned by Pliny are so patently absurd, and many rational prescriptions, particularly for dentifrices, are offered.

Galen. Opera qvintvs tomvs. Basileae: Froben, 1549.

Galen. Librorvm prima classis natvram corporis hvmani. Venetiis: Apvd Iuntas, 1586.

A Greek by birth, Claudius Galen practised during the second century A.D. in Rome, where he achieved great renown. He is regarded after Hippocrates as the greatest physician of the ancient world. His medical writings, which exist in numerous editions, had enormous influence, and were still being extensively cited in the sixteenth century. References to the teeth are scattered throughout Galen's writings. In De usu partium corporis humani, he accurately classifies teeth as incisors, canines and molars, and explains their different functions. He was the first to remark on the nerves of the teeth, and to suggest that the dental pulp was the nutritive element of the tooth. He falls into error, however, in believing that the teeth are bones, and in repeating the Aristotelian fallacy that mastication checks the growth of the teeth. In the field of dental therapeutics, contained mainly in De compositione

pharmacorum, he provides several remedies for toothache, including vapour baths and lotions. For strengthening the teeth and gums he prescribes various astringents and tonics. In cases of persistent toothache, Galen made a small perforation in the affected tooth through which medications could then be introduced. Some of Galen's prescriptions verge on sorcery: to facilitate dentition, for instance, he recommends rubbing the infant's gums with bitch's milk, or the brain of a hare.

CASE 4: THE MIDDLE AGES

Throughout the Middle Ages little new was added to medical science. The period was dominated by the Arabs, who kept alive the classical tradition of Greek and Roman medicine. The medical writings of the Arabs consist essentially of commentaries on the works of Hippocrates and Galen, with few original contributions. The principal merit of Arabic medicine was the great attention it paid to dietetics and general rules of hygiene.

Rhazes. Tractatus nonvs ad regem Almansorem, de curatione morboru particularium. Parisiis: Apud Simonem Colinaeum, 1534.

One of the greatest Arab physicians was Abū Bakr Muḥammad ibn Zakarīyā al-Rāzī, better known by the latinized form of his name, Rhazes, who was active in Baghdad in the late ninth and early tenth century. Rhazes's writings are typical of Arabic medical works. They are essentially a collection of all medical knowledge of the time, punctuated by numerous quotations from Greek and Arab authors, and interspersed with personal observations.

Rhazes's Tractatus nonus ad regem Almansorem, a translation of Kitab al-Mansuri, a medical treatise dedicated to the Persian sovereign, contains a number of passages on dental anatomy. Rhazes describes the arrangement and function of the teeth as well as the action of the mandible during mastication. For loose teeth he prescribes astringent mouthwashes and provides recipes for several dentifrice powders. Preventative treatment is emphasized and the cleaning of the teeth after each meal recommended.

Albucasis. Methodvs medendi. Basileae: Per Henricvm Petrvm, 1541.

Another luminary of Arabic medicine was Albucasis, the latinized name of Abū 'l-Qāsim Khalaf ibn `Abbās al-Zahrāwī,

born near Cordova in Spain in the tenth century. His principal medical work, translated into Latin as Methodus medendi, provides a detailed description of the technique of extracting teeth. Following Celsus, Albucasis recommends the extraction of a diseased tooth only when all other remedies have failed. He insists that the operation be performed by a trained surgeon rather than by the "ignorant barber-surgeons" who customarily drew teeth. Albucasis's treatise is of special value as it contains many illustrations of surgical instruments including those used in the scaling and extraction of teeth.

Regimen sanitatis Salerna, or, The schoole of Salernes regiment of health. London: Printed by B. Alsop and T. Favvcet, 1634.

The best known literary survival of mediaeval medicine is the poem commonly known as Regimen sanitatis Salernitanum, written at the celebrated medical school of Salerno. The poem was held in great esteem as a standard textbook for several centuries. Before the invention of printing the Regimen was spread over the civilized world in numerous manuscript copies. Between 1480 and 1500 alone, more than twenty editions of the poem were printed. In addition, it was translated into many languages. Authorship of the poem was once attributed to Joannes de Mediolano (John of Milan), but it is now generally thought to be a composite work written over a long period between the twelfth and fourteenth centuries.

The Regimen is a handbook of domestic medicine, intended for the guidance of laymen. The influence of Arabic medicine on the school is clearly reflected in the series of maxims on the care of the health that makes up the poem. The section dealing with the teeth refers to the worm that was thought to be responsible for toothache -- a belief originating in ancient Babylon and persisting until the eighteenth century, when it was finally refuted by Fauchard.

Guy de Chauliac. In arte medica exercitatissimi chirurgia. Lvgdvni: Apvd heredes Iacobi Iuntae, 1559.

One of the greatest surgeons of the Middle Ages, and personal physician to three popes at Avignon, Guy de Chauliac wrote his Chirurgia magna in 1363. The great popularity of the work is attested to by the large number of manuscript copies that have survived. It was printed for the first time in 1478, and about 130 editions appeared during the next few centuries.

Guy de Chauliac made no major contribution to dentistry, his work being derived largely from Arabic writers. He earns a place in the history of dentistry, however, by virtue of his

being the first to use the word "dentatores" (misprinted as "detentatoribus" in the edition displayed here), or "dentistae" in some versions. Mention is made of the wide range of special instruments employed by the "dentatores" -- an indication that they were much more than the "ignorant barber-surgeons" of whom Albucasis had complained. From the author's remarks, it would appear that the dentatores were physicians' assistants, skilled in the art of extracting teeth, an operation they performed under the physician's supervision.

CASE 5: THE SIXTEENTH CENTURY

No discernible progress was made in dentistry between the ancient period and the sixteenth century. But in the fifteenth century two important factors changed the whole complexion of learning: the first was the great revival in art and science that occurred during the Renaissance; the second was the invention of printing by Johann Gutenberg around 1450, which made possible the wide dissemination of the new ideas. The new spirit was soon felt in medicine towards the end of the fifteenth century. Editions of the ancient authors were printed for the first time, and were followed by original works which introduced fresh ideas and observations. During the sixteenth century the contributions of Vesalius and Paré, in anatomy and surgery respectively, produced a transformation that led directly to progress in the field of dentistry, and it is during this century that the first specialized treatises on dentistry appear.

Andreas Vesalius. <u>De humani corporis fabrica libri septem</u>. Basileae: Ex officina I. Oporini, 1543.

In 1543 Andreas Vesalius (1514-1564) inaugurated a new era in human anatomy with the publication of his <u>De humani corporis fabrica</u>, one of the great landmarks in the history of medicine. Basing his study on the dissections he carried out at the University of Padua, Vesalius daringly challenged many of Galen's anatomical doctrines, and corrected many of his long-standing errors. The magnificently illustrated <u>De humani corporis fabrica</u> presents a complete description of all parts of the human body. Although Vesalius's treatment of the teeth is not as accurate as that of other parts of the body, it nevertheless represents a significant advance over the work of Galen and his disciples. Vesalius enumerates the characteristics that distinguish teeth from bones, but repeats Aristotle's fallacy concerning the continuous growth of the teeth. He paid great attention to the structure of the teeth, particularly to the root system. Problems connected with the impaction of wisdom teeth are discussed and appropriate surgical procedures

recommended.

Following Vesalius's pioneering example, the study of anatomy, the very basis of scientific medicine, began to flourish.

Bartolomeo Eustachi. Opuscula anatomica. Lugduni Batavorum: Apud J. vander Linden, 1707.

Bartolomeo Eustachi. Tabulae anatomicae ... Praefatione, ac notis illustravit Joh. Maria Lancisius. Editio romana altera. Romae: Sumptibus L. & T. Pagliarini, 1728.

One of the few specialized monographs on the teeth in the sixteenth century was Libellus de dentibus, written by the distinguished anatomist Bartolomeo Eustachi (d. 1574), and printed at Venice in 1563. Eustachi's researches into dental anatomy and dentition considerably advanced the work of Vesalius. Among Eustachi's contributions to dentistry was his differentiation between the enamel and dentine of the tooth. In addition he was the first to mention the ligaments attaching the roots of the teeth to the alveoli. In describing dental formation, he confirmed Hippocrates's assertion that the teeth are formed in the infant during the foetal stage. Eustachi also corrected several age-old fallacies, such as the belief in the continuous growth of the teeth, first stated by Aristotle and repeated by Vesalius. He was the first to assert that the second teeth have their own dental sac and do not originate, as Vesalius believed, from the roots of the milk teeth. Eustachi's study was reprinted as Tractatus de dentibus in the 1707 edition of his works displayed here.

In 1714 Eustachi's Tabulae anatomicae, unpublished during his lifetime, appeared for the first time. The copper engraved plates which make up this volume were lost for one and a half centuries until their rediscovery by Lancisi, who published them with a commentary. A second edition, shown here, was published in 1728.

Ambroise Paré. Opera. Latinitate donata Iacobi Gvillemeav. Parisiis: Apud Iacobvm Dv-Pvys, 1582.

Ambroise Paré. The workes. Translated out of Latin and compared with the French by Tho. Johnson. London: R. Cotes and W. Du-gard, 1649.

Renowned as a great military surgeon, Ambroise Paré (1510?-1590) began his medical career as an apprentice to a barber-surgeon in Paris, where he undoubtedly learned the art of drawing teeth and acquired experience in the practice of dental

surgery. In his surgical writings dental maladies and their treatment are described at length. Paré's observations of the anatomy and physiology of the teeth are more or less a reiteration of Galen and display little originality. More interesting are his chapters on diagnosis, in which he classifies the various kind of pain attendant on dental disorders and relates them to their probable causes. He describes in some detail the surgical procedures of extraction, laying great emphasis on the position of the patient and post-operative care. The instruments used in surgery are also described and illustrated. Aware of the dangers accompanying extraction, Paré warns against the use of excessive force which could result in the death of the patient. One undesirable, but apparently common, practice advocated by Paré in cases of difficult extraction, is to break the crown of the tooth, thus destroying the nerve, but leaving behind the base and root. Paré was the first to use obturators in cases of palatal defects caused through injury or syphilitic ulcers. He was also the first to describe the method of transplanting artificial teeth made from ivory or bone.

Paré originally wrote his works in French. Displayed here are a Latin translation of 1582, and an English version of 1649.

Jacob Horst. De avreo dente maxillari pveri Silesii. Lipsiae: Impensis Valentini Vaegelini, 1595.

A curious episode in the annals of dentistry is the story of the golden tooth. In 1593 it was reported from Silesia that a golden tooth had erupted in the mouth of a seven-year old boy. The sensational news spread rapidly throughout Germany and beyond, and prompted a number of learned dissertations. Jacob Horst, professor of medicine at the University of Helmstadt, after examining the boy's mouth, declared the phenomenon to be the result of astrological forces: on the 22 December 1585, the boy's birthday, the sun was in conjunction with Saturn in the sign of Aries. The intense heat that this configuration produced so increased the nutritive force in the boy's body, that instead of an osseous tooth, a golden one sprang forth. Horst proclaimed this auspicious event to be a portent of the dawn of a Golden Age, in which the Roman Emperor would expel the Turks from Europe. Incredibly, Horst's absurd claims were taken seriously by other physicians. Eventually the golden tooth was exposed as a clever fake and the boy sent to prison.

CASE 6: THE SEVENTEENTH CENTURY

The first indications of a separation of dental science from general medicine appeared in the sixteenth century with the publication of specialized dental monographs. During the

seventeenth century dental works became more numerous and dentistry made further progress both in its scientific and practical aspects.

Nathaniel Highmore. Corporis hvmani disqvisitio anatomica. Hagae-Comitis: Ex officina Samuelis Broun, 1651.

The maxillary sinus was described in detail for the first time in 1651 by Nathaniel Highmore (1613-1685), though he was not its discoverer, as is sometimes claimed. He was the first, however, to establish the existence of a communication between the maxillary sinus, or Highmore's antrum as it was called, and the mouth -- an observation that was of great importance to dentistry. Although Highmore did not offer any treatment for diseases of the maxillary sinus, he opened the way for the successful operations performed by William Cowper and James Drake at the end of the century.

Johannes Scultetus. Armamentarium churvrqicvm. Hagae-Comitum: Ex officina Adriani Vlacq, 1657.

Johannes Scultetus. The chyrurgeons store-house. Faithfully Englished, by E.B. London: J. Starkey, 1674.

In his Armamentarium chirurqicum Johannes Scultetus (Johann Schultes, 1595-1645) described and illustrated all the surgical instruments in use during his time. The work was first published posthumously in Latin in 1655 and was subsequently translated into several languages. Displayed here are a Latin edition of 1657, and an English translation of 1674. One plate illustrates some of the instruments used in dental and oral surgery: the pelican, various kinds of forceps, bifid and trifid elevators, dentiscalps, a funnel or cannula for feeding patients with trismus (lockjaw) and a screw dilator. The other plate shows various oral operations, including the cauterization of a carious tooth; the removal of a tooth that has penetrated the cheek; the insertion of a palatal obturator; the examination of the pharynx by means of an oral speculum; the detachment of a frenum; and the removal of a foreign object from the pharynx.

Wilhelm Fabricius von Hilden. Opera, quae extant omnia. Francofurti ad Moenum: Typis ac sumptibus Balth. Christophori Wustii, 1682.

Observationum et curationum chirurqicarum centuriae sex, by Wilhelm Fabricius von Hilden (Fabricius Hildanus, 1560-1634),

included in this 1682 edition of his works, is a collection of 600 case studies, a popular form of medical literature in the seventeenth century. The tenth observation of the second "centuria" refers to the case of a woman who suffered from severe headaches for four years. Having established a link between the headaches and the condition of the woman's teeth, Fabricius von Hilden effected a cure by extracting four diseased teeth. The author concludes by urging practitioners to undertake a dental examination in suspected cases of trigeminal neuralgia, before taking more radical measures.

Anthony von Leeuwenhoek. "Microscopical observations of the structure of teeth and other bones." Philosophical transactions of the Royal Society, no. 140 (July-August, 1678).

Microscopy added a new dimension to the study of dentistry, and led to several important discoveries towards the end of the seventeenth century. During his researches, the amateur Dutch scientist Anthony von Leeuwenhoek, discovered the minute tubular structure of the teeth. He described his findings in a letter to the Royal Society in 1678. In 1683 Leeuwenhoek was the first to see micro-organisms, or "animalcules" as he called them, in tooth plaque and saliva.

Pierre Dionis. A course of chirurgical operations, demonstrated in the Royal Garden at Paris. London: J. Tonson, 1710.

As surgeon in ordinary to Louis XIV, Pierre Dionis (d. 1718) was responsible for demonstrating various surgical operations to students at the Jardin Royal. Although Dionis's demonstrations were carried out during the last decade of the seventeenth century, an account of them was not published until 1707. The first English translation appeared in 1710.

Dionis believed that dental caries was caused by the flow of caustic fluids through the periodontal membrane, and that the teeth could be saved by redirecting the flow. If this failed, cauterization with vitriol (sulphuric acid), or extraction was recommended. When extraction was necessary, Dionis preferred to entrust the operation to "operators for the teeth," despite the fact that many of them were charlatans. Dionis's work contains interesting illustrations of instrument tables. Shown here are the instruments used in dental operations.

Anton Nuck. Operationes et experimenta chirurgica. Editio novissima. Lugduni Batavorum: Apud Samuelem Luchtmans, 1733.

A renowned professor of medicine at Leiden, Anton Nuck (1650-1692) emphasised the complete knowledge of oral anatomy as a necessary pre-condition to performing surgical operations. He insisted, furthermore, that each kind of tooth should be removed with the appropriate instrument. Nuck is chiefly remembered for his recommendation of hippopotamus tusk as a more suitable material for the manufacture of artificial teeth, since it did not turn yellow, as did elephant ivory, by the action of food and saliva.

Operationes et experimenta chirurgica was first published in 1692, the year of Nuck's death. It was reprinted in 1714 and again in 1733.

CASE 7: THE EIGHTEENTH CENTURY: FRANCE

Gradual but undeniable progress had been made in dental science during the sixteenth and seventeenth centuries, and by the close of the seventeenth century dentistry had began to emerge as a true speciality, although the number of skilled practitioners was still relatively small. The steady increase in the number of specialized treatises on the teeth, together with the accumulated knowledge acquired in surgical practice, were the conditions that led inevitably to the separation of dentistry from general medicine. The leading role in this separation, which occurred in the eighteenth century, was taken by the French, and in particular by Pierre Fauchard who is regarded as the founder of modern dentistry.

Pierre Fauchard. Le chirurgien dentiste, ou, Traité des dents. A Paris: Chez Jean Mariette, 1728.

With the publication of Le chirurgien dentiste in 1728, Fauchard presents, in a single work, an integrated doctrine of dental science, both in its therapeutic and practical aspects, thus providing dentistry with a solid scientific foundation. Drawing on the publications of leading surgeons and anatomists, on the practical knowledge of tooth-drawers, and on his own considerable experience, Fauchard treats the numerous and varied aspects of dentistry from the historical, theoretical and practical standpoints. Considerable space is devoted to anatomy, and to the care and hygiene of the teeth. In a lengthy discussion of the pathology of over a hundred dental, alveolar and gingival diseases, Fauchard takes the opportunity to dispel several age-old myths, such as the tooth worm, and many of the

dubious remedies against toothache. He is also critical of the cauterization of decayed teeth with acid, as advocated by Dionis.

In discussing dental surgery Fauchard deplores the relative lack of formal training, and emphasises the need for a thorough theoretical knowledge, in addition to a skilful hand. The relative positions of patient and dentist are carefully delineated, and the instruments used in various operations and in the cleansing of the teeth are explained in detail with illustrations.

The sections dealing with prostheses are of great interest, as they include Fauchard's own inventions and improvements to dentures. In addition to using hippopotamus tusk, walrus ivory, ox bone and human teeth as substitutes, Fauchard also makes one of the earliest attempts at fashioning artificial teeth from inorganic material (a mixture of bone, metal and porcelain). A wide variety of dentures and obturators, several of them invented or improved by Fauchard, are also described.

The significance of Fauchard's work was immediately recognized in his native land. Many of his colleagues, encouraged by his example, felt confident enough to reveal their knowledge to the world, and in the course of the century a comprehensive body of dental literature was established firstly in France, and then in other European countries.

Claude Jacquier de Geraudly. L'art de conserver les dents. A Paris: Chez l'auteur et P.G. Le Mercier, 1737.

The first Frenchman to follow Fauchard's lead was Geraudly, whose L'art de conserver les dents appeared in 1737. Addressed chiefly to laymen, it offers little to advance practical dentistry, although Geraudly makes some interesting remarks on dental transplantation, including the recommendation that the donor be between ten and fifteen years old. Despite the merits of the work, the old spirit of charlatanism is still apparent in the secret medications, elixirs and potions offered for sale by the author.

Robert Bunon. Essay sur les maladies des dents. A Paris: Chez Briasson, Chaubert et De Hansy, 1743.

Robert Bunon. Experiences et demonstrations faites a l'hôpital de la Salpêtriere, & à S. Côme en présence de l'Académie royale de chirurgie. A Paris: Chez Briasson, Chaubert et la veuve Pissot, 1746.

Inspired by Fauchard's work, Robert Bunon published a number of books on dentistry between 1741 and 1746, two of which are included in the exhibition. The enthusiastic reception of

Essay sur les maladies des dents on its publication in 1743 encouraged Bunon to issue a sequel which appeared in 1746 as Experiences et demonstrations. Bunon's major concern was the prevention of tooth decay. He paid great attention to dentition and demonstrated that in children who had suffered from rickets, scurvy, measles, smallpox and other diseases, the enamel of unerupted teeth was prone to erosion (hypoplasia). He distinguished several kinds of tooth tartar, which he regarded as the greatest enemy to healthy teeth and the primary cause of gingivitis.

Henry de Lécluse. Nouveaux élémens d'odontologie. A Paris: Chez Delaguette, 1754.

Dividing his energies between acting and surgery, the versatile Lécluse wrote several dental works, the most significant of which is Nouveaux élémens d'odontologie, which was first published in 1754, a second edition appearing in 1782. The work consists of a detailed account of dental anatomy, followed by a practical section in which the author enthusiastically endorses dental replantation. Several new instruments are described, including Lécluse's own specialized elevator, equipped with an adjustable joint, used in extracting the lower third molar. The instrument, which bears its inventor's name, is still in use today.

Etienne Bourdet. Recherches et observations sur toutes les parties de l'art du dentiste. A Paris: Chez Jean Thomas Hérissant, 1757.

Etienne Bourdet. Soins facile pour la propreté de la bouche, pour la conservation des dents, & pour faire éviter aux enfans les accidens de la dentition. Nouvelle édition. A Paris: Chez Jean-Th. Hérissant, 1771.

Bourdet's distinction as a dental surgeon earned him the prestigious appointment as dentist to Louis XV and Louis XVI. His important two-volume Recherches et observations, first published in 1757, was a great success and was widely translated (a Russian translation of 1790 was the first textbook on dentistry to appear in that language). In the preface to his work, Bourdet, like Bunon, acknowledges his debt to Fauchard, and covers much the same ground as his mentor, adding much that is original. In the field of orthodontics he improves considerably on Fauchard, and describes a number of original orthodontic contrivances. He also manufactured several prosthetic pieces, including dentures, and an obturator that attached to the teeth by means of lateral clasps.

Bourdet's other work, first published in 1759, is a useful textbook on the care and hygiene of the teeth, particularly in children.

Anselme Jourdain. Traité des maladies et des opérations réellement chirurgicales de la bouche, et des parties qui y correspondent. A Paris: Chez Valleyre l'aîné, 1778.

Jourdain's treatise on diseases and surgical operations of the mouth was the most comprehensive work of its kind during the eighteenth century, and was highly regarded well into the nineteenth century (the first English translation appeared in 1849 -- over seventy years after the publication of the first French edition). In the first volume, which is devoted to diseases of the maxilla, maladies of the maxillary sinus (the particular speciality of the author) are described in exacting detail. The second volume examines diseases of the mandible, as well as those of the lips, cheeks, tongue, salivary ducts, and gums. Dental haemorrhage and problems of dentition are also discussed.

Nicolas Dubois de Chemant. A dissertation on artificial teeth. 4th edition. London: T. Bensley, 1804.

Alexis Duchâteau, a Parisian chemist, dissatisfied with his own decaying and malodorous dentures made from hippopotamus tusk, hit upon the idea of manufacturing artificial teeth of porcelain. After numerous unsuccessful experiments he turned to a prominent dentist, Nicolas Dubois de Chemant, for his advice. Duchâteau finally produced a satisfactory denture in 1774, but was unsuccessful in promoting his invention. In 1787, having elicited Duchâteau's prescription, Dubois de Chemant made further experiments, eventually resulting in an imperishable, odourless denture, which he announced to the world in 1788 in his Dissertation sur les avantages des nouvelles dents et rateliers artificiels incorruptibles et sans odeur.

After some initial opposition in France, Dubois de Chemant obtained a patent for his invention in 1791. Duchâteau, claiming the invention was his, tried unsuccessfully to bring an action against Dubois de Chemant and to have the patent revoked. Meanwhile Dubois de Chemant left revolution-torn France and settled in England where he was awarded a royal patent. Artificial teeth enjoyed such a vogue that the famous caricaturist Thomas Rowlandson made them the subject of one of his etchings. The success of mineral paste teeth was matched by the popularity of Dubois de Chemant's book, which went into several editions within a few years.

CASE 8: THE EIGHTEENTH CENTURY: BRITAIN

The inspiration of Fauchard's pioneering work soon spread to France's neighbours, particularly to the German-speaking countries. In Great Britain the influence was indirect, since no English translation of Fauchard's work was undertaken during the eighteenth century (the first English translation appeared only in 1946). Yet it is clear from the literature that British dental specialists were acquainted with the works of Fauchard and of his leading fellow-countrymen.

The main thrust of French dental literature tended towards operative dentistry. The British dentists, on the other hand, were more concerned with the theoretical aspects of dentistry. In particular, the works of John Hunter in dental anatomy and physiology had a profound influence on scientific dentistry and paved the way for many of the advances made in dental science during the following century.

Joseph Hurlock. A practical treatise upon dentition, or, The breeding of teeth in children. London: Printed for the author, 1742.

The literature of dental science in Great Britain begins with Hurlock's treatise, published in 1742. The author strongly advocates the lancing of gums in infants to facilitate the eruption of the primary teeth and thereby prevent convulsions, fever, and even death. In support of his case, Hurlock adduces statistical evidence of infant mortality caused by teething complications. Perhaps as a result of Hurlock's treatise, the lancing of gums became standard practice in British dentistry until well into the nineteenth century. A keen observer, Hurlock suggested that caries in deciduous teeth was the result of bad diet, and recommended that children be sent into the countryside for fresh air and wholesome food.

Thomas Berdmore. A treatise on the disorders and deformities of the teeth and gums. A new edition with additions. London: Printed for the author, 1770.

A major contribution to the progress of dentistry in Britain was made by Thomas Berdmore, dentist to George III (the first such appointment). Based on his experiences as a practitioner, Berdmore's treatise is considered to be the first dental textbook in England. It went into several editions and translations, and was re-issued as late as 1844, seventy-six years after the appearance of the first edition in 1768 -- a clear testimony of its continued value.

Berdmore endeavoured to find a cure for dental caries, and

investigated the composition of the tooth. He laid great emphasis on hygiene, recommending cleaning with a toothbrush rather than with a cloth or sponge. He opposed the use of metallic toothpicks, and advised the public how to distinguish between beneficial and destructive dentifrices. Berdmore was strongly opposed to the transplantion of teeth, but he had occasional recourse to replantation of extracted carious teeth, after they had been cleaned and filled with lead or gold.

John Hunter. The natural history of the human teeth. 2nd edition. London: J. Johnson, 1778.

John Hunter. A practical treatise on the diseases of the teeth. London: J. Johnson, 1778.

A pioneer of experimental pathology, and one of Britain's greatest anatomists, John Hunter wrote two important treatises on the teeth that laid the foundation of modern scientific dentistry. The first, published in 1771, initiated a scientific approach to the anatomy of the teeth and jaws that contrasted with the empirical methods hitherto employed. The structure of the teeth and the physiological action of the jaws are described in detail. The development and growth of dentition are also treated at length. Hunter found that teeth are composed of two tissues, which he called enamel and bone (i.e. dentine). The enamel cuticle and the thin cementum which covers the tooth were yet to be discovered. Hunter also added the terms cuspids and bicuspids to the dental lexicon.

Hunter's second treatise, intended as a supplement to The natural history of the human teeth, and first published in 1778, suffered from Hunter's lack of training as a dentist. He approached his subject from the standpoint of a general surgeon, and many of his pronouncements are of little practical value. He pays particular attention to malocclusions and dental anomalies, and suggests appropriate corrective treatment. Much space is devoted to the transplantation of teeth from one person to another, though Hunter is apparently unaware of the dangers of disease that transplantation could cause.

Hunter's classic works on the teeth became standard textbooks on dental anatomy, and are milestones in the history of dentistry. They were reprinted many times and were translated into all the major European languages.

Robert Wooffendale. Practical observations on the human teeth. London: J. Johnson, 1783.

Robert Wooffendale began his career in dentistry as an apprentice to Thomas Berdmore in 1765. After a brief stay in

the United States he returned to England where he established a practice. His Practical observations on the human teeth, written primarily for the benefit of laymen, explains the structure of the teeth, their diseases, and offers advice on dental care and hygiene. In 1795 Wooffendale returned to the United States where he played a leading part in the development of dentistry in that country.

Robert Blake. Disputatio medica inauguralis De dentium formatione et structura in homine et in variis animalibus. Edinburgi: Apud R. Allan, 1798.

Robert Blake. An essay on the structure and formation of the teeth in man and various animals. Dublin: W. Porter, 1801.

The inaugural dissertation of Robert Blake was a major contribution to dental and comparative anatomy. Building on the foundation laid by Hunter, Blake makes several original observations. Published originally in Latin, the traditional language of academic discourse, the dissertation soon appeared in an English translation in 1801. The work had considerable influence throughout the first half of the nineteenth century, and was still highly regarded by the dental profession in 1848, when the American Society of Dental Surgeons issued a reprint.

READING ROOM CASES: THE NINETEENTH CENTURY

Building on the scientific foundation established during the eighteenth century, dentistry made rapid advances during the nineteenth century, both in its theoretical and practical aspects. It was an age of technological progress, which brought great benefits to the practice of dentistry. The consolidation of dentistry as a profession also took place during this period, with the establishment of dental colleges, societies and periodicals in many countries. Leading the way towards the professionalization and mechanization of dentistry was the United States, which in the nineteenth century enjoyed the pre-eminent position in dentistry that France had assumed in the eighteenth. The century also saw the discovery of anaesthesia, dentistry's greatest contribution to medicine.

WEST READING ROOM

CASE 1: BRITAIN AND FRANCE

Joseph Fox. The natural history of the human teeth. London: T. Cox, 1803; with, as issued, The history and treatment of the diseases of the teeth, the gums, and the alveolar processes, with the operations which they require. London: J. Swan, 1806.

Fox, a student of Hunter, was appointed in 1799 as dental surgeon to Guy's Hospital in London, the first hospital to include a dental surgeon in its staff, and the first to institute special courses of dental lectures. Fox published his lectures in the two works shown here. In the introduction he pays tribute to Hunter, but notes the deficiencies of his teacher's book in regard to the second dentition and irregularities of the teeth -- deficiencies which Fox seeks to rectify in his own work. Fox recommends the extraction of the primary teeth to prevent occlusal anomalies, an unfortunate practice that endured well into the twentieth century.

Thomas Bell. The anatomy, physiology, and diseases of the teeth. 2nd edition. London: S. Highley, 1835.

Thomas Bell succeeded Joseph Fox as lecturer in dentistry at Guy's Hospital in 1817. His treatise on the teeth, shown here in a second edition, first appeared in 1829, and is largely a compilation of Hunter, Blake and Fox, though he takes issue with Fox over the extraction of primary teeth.

Sir John Tomes. A system of dental surgery. Philadelphia: Lindsay & Blakiston, 1859.

The leading light of British dentistry in the nineteenth century was Sir John Tomes. In addition to his distinguished contributions to theoretical dentistry, Tomes invented instruments and machines that were of enormous practical value. His histological research led to the discovery of dentinal fibrils ("Tomes's fibres"), which he announced to the Royal Society in 1856. Prior to this, he had patented a "dentifactor," an ingenious machine used in the manufacture of dentures. Tomes also developed anatomically-shaped forceps, the jaws of which were adapted to the forms of various teeth. This invention was the first example of the modern types of forceps that replaced the old key extractors. Receptive to new developments in practical dentistry, Tomes defended the use of amalgam, and was one of the first in England to use ether as an anaesthetic.

Throughout his life Tomes actively promoted the cause of dentistry, and was one of the founder members of the Odontological Society in 1856. In 1858 he founded the Dental Hospital of London, where he gave clinical demonstrations. He was also successful in persuading the Royal College of Surgeons to grant a license in dental surgery. In 1880 he was elected as the first president of the newly created British Dental Association.

Christophe François Delabarre. Traité de la partie mécanique de l'art du chirurgien-dentiste. A Paris: Chez l'auteur, 1820.

The first dental writer to provide a scientific treatment of prosthetics, C.F. Delabarre, introduced many improvements on existing methods of prosthesis and orthodontics. His inventions include a complex spring device to hold the upper denture in place. He improved on Bourdet's palatal obturator which was attached to the teeth by means of clasps, and was the first to devise an obturator for the soft palate. The idea of constructing a model of the teeth from an impression made in soft wax also belongs to Delabarre.

Malagou Antoine Désirabode. Nouveaux éléments complets de la science et de l'art du dentiste. Paris: Béchet jeune, 1843.

In this work Désirabode provides a summary of the customary methods of fastening teeth, and considers the advantages and disadvantages of each procedure. He rejects attachment by means of a screw-in post in favour of a single pin. Désirabode was one of the first dentists to consider the question of caries prevention, and to remark on the beneficial effects of fluoride compounds on the teeth.

Emile Magitot. Étude sur le développement et la structure des dents humaines. Paris: J.-B. Baillière, 1858.

The leading figure in French stomatology, Emile Magitot, made several significant contributions to scientific dentistry. He was the first to describe the formation of secondary dentine by the dental pulp, and gave an excellent account of the dental follicle. In 1888 he founded the Societe de Stomatologie, and in 1894 he launched the Revue de stomatologie, which is still being issued today. Magitot might have become France's counterpart of Britain's Sir John Tomes, but his innate conservatism prevented him from accepting many of the new theories and ideas of his day.

CASE 2: THE UNITED STATES

Chapin A. Harris. The dental art, a practical treatise on dental surgery. Baltimore: Armstrong & Berry, 1839.

The American journal of dental science, v. 1, no. 1 (1839).

Harris's The dental art was one of the most influential and most frequently published dental works of the nineteenth century. First published in 1839, it was re-issued thirteen times during the rest of the century.

The professionalization of dentistry in the United States was due in large part to the efforts of Harris and his older colleague, Horace H. Hayden. In 1840 they were co-founders of the Baltimore College of Dental Surgery, the first institution of its kind in the world. The same year they collaborated in forming the first national association of dentists, the American Society of Dental Surgeons. The two men were also instrumental in founding the world's first periodical devoted exclusively to dentistry. The American Journal of dental science, edited by Harris and Eleazar Parmly. The first issue was published 1 June 1839 and included articles by Elisha Baker, Solyman Brown, Eleazar Parmly and J. Foster Flagg.

Green Vardiman Black. Descriptive anatomy of the human teeth. Philadelphia: Wilmington Dental Mfg. Co., 1890.

One of the most prominent names in American dentistry is that of G.V. Black, who contributed over five hundred articles as well as several books on aspects of dentistry. In operative dentistry he made a number of significant contributions. In addition to his invention of machines for testing alloys used in tooth fillings, he standardized operative procedures, in particular those relating to the preparation of cavities for filling, which he demonstrated to his students on oversize models with mammoth hand instruments. Black also introduced the principle of bringing the margins of fillings to the point where they could be easily reached by a toothbrush.

ANAESTHESIA

George T. Barker. Instructions in the preparation, administration, and properties of nitrous oxide, protoxide of nitrogen, or laughing gas. Philadelphia: Rubencame and Stockton, 1866.

Truman Smith. An inquiry into the origin of modern anaesthesia. Hartford: Brown and Gross, 1867.

To dentists belongs the credit for the introduction of at least two kinds of general anaesthesia. In 1844 Horace Wells, a dentist from Hartford, Connecticut, had one of his own molars extracted while under the influence of nitrous oxide, a gas discovered by Joseph Priestly in 1776. In 1845 Wells gave a public demonstration to a sceptical audience in Boston. Unfortunately, the patient, though quite unconscious and insensible to pain, cried out. Wells was disgraced, and nitrous oxide discredited.

The following year W.T.G. Morton, to whom Wells had communicated his discovery, successfully used ether as an anaesthetic. A successful public operation, in which Morton administered the ether, demonstrated the efficacy of the anaesthetic. News of the event spread rapidly around the world, and for a time ether was the most widely used anaesthetic, being replaced briefly by chloroform. In the 1860s nitrous oxide was re-introduced in the United States by Gardner Quincy Colton, and became the most popular anaesthetic used in dentistry. It began to gain acceptance in Europe in the 1870s following demonstrations of its use by Thomas W. Evans, an American dentist practising in Paris.

Controversy over the priority of the discovery of anaesthesia raged for years. Congress offered a large award to the discoverer, but was forced to withdraw it. In 1870 Wells was finally recognized as the true discoverer. Unfortunately, he did not live to enjoy the acclaim, having commited suicide in 1848. Morton died in destitution.

As a local anaesthetic, cocaine was widely used in the final part of the century, but the undesirable addictive properties of the drug far outweighed its advantages. Cocaine was eventually replaced by novocaine, developed by the German chemist Alfred Einhorn in the first decade of the present century.

EAST READING ROOM

CASE 1: CANADA

Levi S. Parmly. The summum bonum. Quebec: J. Neilson, 1815 [Montreal, 1970].

Many of Canada's dentists in the early nineteenth century were itinerant practitioners from the United States. Levi Spear Parmly came to Canada from Vermont and established a practice, firstly in Montreal, and then in Quebec City. His Summum bonum has the distinction of being the first Canadian book of dentistry. A recent facsimile edition is displayed here.

Eleazar Gidney. A treatise on the structure, diseases, and management of the human teeth. Utica: Printed for the author by A.G. Dauby, 1824.

Eleazar Gidney was one of the most successful itinerant dental practitioners of the early nineteenth century. He practised in New York, Baltimore, and Utica before coming to York (Toronto) in 1825. The following year he went to Quebec City and then to Manchester in England. In 1832 he returned to York, where his patients included Lady Colborne, wife of the Lieutenant Governor.

Shearjashub Spooner. Guide to sound teeth, or, A popular treatise on the teeth. 2nd edition. New-York: Collins, Keese, 1838.

Shearjashub Spooner was the younger brother of John Roach Spooner, who achieved fame by re-introducing sulphide of arsenic for pulp devitalization -- a method last used by Arabic physicians of the Middle Ages. Both brothers practised for a time in Montreal, where John remained until 1841. In 1833 Shearjashub returned to the United States, where in 1836 he published a book in which he describes the use of arsenic in dentistry. A second edition appeared in 1838.

Ontario Dental Association. Constitution and by-laws. Woodstock: A. M'Cleneghan, 1868.

The first organization of Canadian dentists was the Ontario Dental Association, whose constitution and by-laws were adopted at a meeting held in Cobourg on 2 July 1867. John O'Donnell was appointed as president. One of the first resolutions of the new

association was to secure legislation: on 4 March 1868 the Legislature of the Province of Ontario passed a comprehensive dental act, the first of its kind in the world. The act incorporated the Royal College of Dental Surgeons of Ontario, granting it full powers of licensing, teaching, and regulating the practice of dentistry in the province. Licence requirements stipulated five years of continuous practice in a dental office. The act provided the pattern for other provinces which soon followed suit, beginning with the Dental Association of the Province of Quebec, incorporated on 4 April 1869.

W. George Beers. The discriminate use of amalgam for filling teeth. Montreal: J. Lovell, 1871.

The first secretary of the Dental Association of the Province of Quebec was William George Beers, who is perhaps better known as the father of lacrosse in Canada. He was also one of the dominating figures in Canadian dentistry in the second half of the nineteenth century. In 1868 he founded the first dental journal in Canada, the Canada journal of dental science, which began publication in Montreal and ran for eleven years. In the 1870s Beers was involved in a controversy with another Montreal dentist, H.M. Bowker, over the use of amalgam, which Beers defended. The debate raged on the pages of Canadian medical journals for some time, with Beers having the final word. The offprint displayed here is the first of Beers's articles on the subject.

CASE 2: POPULAR WORKS ON THE TEETH

Old Army Surgeon. Economy of the teeth, gums, and interior of the mouth. London: E. Wilson, 1830.

Homer Bostwick. The family dentist, or, A familiar treatise on the art of securing a beautiful set of teeth. New York: G.P. Scott, 1835.

Edwin Saunders. Advice on the care of the teeth. London: T. Ward, 1837.

Solyman Brown. Dental hygeia, a poem, on the health and preservation of the teeth. New-York: Kelly & Fraetas, 1838.

Andrew Nisbet. Pocket guide to the preservation of the teeth. Glasgow: W.R. M'Phun, 1838.

Alfred Canton. The teeth and their preservation, in infancy and manhood, to old age. London: H. Bailliere, 1851.

Henry Planck. A few words of advice on the care of the teeth. Manchester: Johnson and Rawson, 1866.

Matthew Dickie. A popular treatise on the teeth. Glasgow: Porteous Brothers [1870]

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